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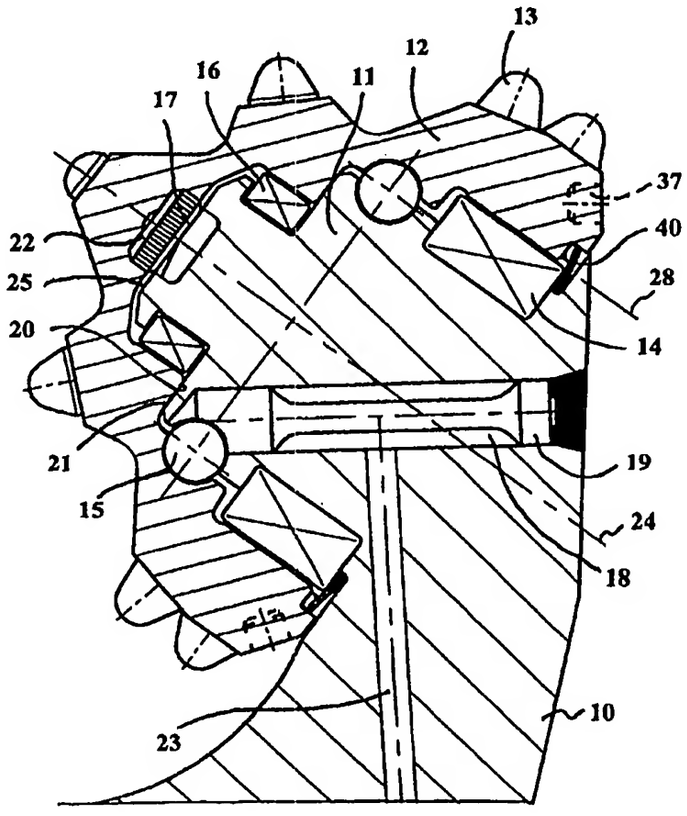
(54) Title: ROCK DRILL BIT AND SEAL MEANS THEREFOR

(57) Abstract

The present invention relates to a rock drill bit for rotary crushing machining of rock. The drill bit comprises legs (10) each carrying a bearing journal (11) provided with bearing surfaces (26, 27) in order to via bearing elements cooperate with races in a thereby rotatable roller cutter equipped with buttons or cutting insert. The leg comprises a tail (30) and seal means (40) intended to counteract entrance of drill cuttings into the bearings, said seal means (40) in addition being intended to retain bearing grease. The seal means (40) is concentrically provided around the bearing journal (11) as well as intended to slide against the roller cutter (12). The bearing journal (11) and the seal means (40) comprise cooperating locking means provided to counteract rotation of the seal means relative to the bearing journal. The invention also relates to a seal means for a rock drill bit.



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ROCK DRILL BIT AND SEAL MEANS THEREFOR

Background of the invention

The present invention relates to a rock drill bit for rotary crushing machining of rock, including at least a leg carrying a bearing journal provided with bearing surfaces in order to cooperate with races via bearing elements in a thereby rotatable roller cutter equipped with crushing organ, said leg comprising a tail and seal means intended to counteract entrance of drill cuttings into the bearings, said seal means furthermore being intended to retain bearing grease, said seal means being concentrically provided around the bearing journal and being intended to slide against the roller cutter.

Prior art

Through US-A-5,295,549 a rotary drill bit of the above mentioned type is previously known. The known tool comprises an axially movable seal, having two metallic rings sealed against the roller cutter and the bearing journal via radially compressed rubber rings. The metallic rings rotate relative to each other and abut against each other via polished abutment surfaces. The known tool has five possible places for leakage of drill cuttings to the bearings. Furthermore, the known seal is troublesome to assemble since it contains a plurality of components. In addition oblique positioning of the abutment surfaces is risked since the seal does not have any rebound in the axial direction between the leg and the roller cutter. In addition US-A-3,663,073; US-A-4,560,175 and US-A-4,772,404 disclose seals that are held by friction and/or by gluing. In US-A-3,489,421 the seal is press fitted about the journal and deformed after positioning for retaining the position of the seal.

Objects of the invention

One object of the present invention is to provide a rotary drilling bit at which life-span of the bearings may be extended considerably compared to crowns with conventional seal.

Another object of the present invention is to provide a rotary drilling bit at which mounting of the seal means is simplified considerably compared to crowns with conventional seals.

Another object of the present invention is to provide a rotary drilling bit and a seal means, which provides for an exact and safe location of the seal means

Another object of the present invention is to provide a sealing ring, which has a good resistance against abrasion.

Description of the drawings

These and other objects have been achieved by means of a rock drill bit and a sealing ring according to the features and characteristics laid down in the subsequent claims with reference to the drawings, wherein:

Fig. 1A shows a leg and a roller cutter of a rotary drilling bit according to the present invention, in cross section; Fig. 1B shows an enlarged part of the rotary drilling bit according to Fig. 1A; Fig. 2 shows the end of the leg in a side view, partly in cross section; Fig. 3 shows the end of the leg partly in cross section according to line III-III in Fig. 2; Fig. 4 shows a sealing ring according to the present invention, in plan view; Fig. 5 shows the sealing ring in cross section according to line V-V in Fig. 4; Fig. 6 shows the sealing ring in an enlarged cross section according to line VI-VI in Fig. 4 and Fig. 7 shows the sealing ring in an enlarged cross section according to line VII-VII in Fig. 4.

Detailed description of the invention

With reference to Figs. 1A and 1B is shown a rock drill bit according to the present invention, for rotary crushing drilling of rock, a so called rotary drill bit. The drill bit preferably comprises three legs, whereof a sectioned leg 10 is shown. A bearing journal 11 is formed on the leg. In certain designs of drill bits it is possible to provide only one or two legs. On each bearing journal is a roller cutter 12 provided with buttons 13, rotatably journaled by a cylinder bearing 14, a system of roller bearings 15, a radial bearing 16 as well as an axial bearing 17. The buttons can alternatively be replaced of by other crushing organs, such as chisels or teeth integrated with the roller cutter. The legs 11 are evenly distributed around the circumference of the drill bit with 120° partition. For the adoption of roller bearing balls 15 the bearing journal 11 is provided with a channel 18, in which a peg 19 is received in order to retain the separate balls 15. The cylindrical cylinder bearing 14 receives a large part of the force of reaction from the rock, while the principal task of the roller bearing 15 is to retain the roller cutter 12 on the leg 11. The roller cutter has a shoulder 20 that is brought against a collar 21 on the leg for taking up axial forces, which are not received by the cooperation of a support surface 22 with the axial end surface 25 of the shank. The above mentioned bearings are sealed and lubricated by a lubricating system integrated with the drill bit. The lubricating system is connected with the bearing system by means of the channel 23. Instead of the cylinder bearing 14 a slide bearing can be arranged substantially at the corresponding position. The bearing journal 11 has a central line 24 around which the roller cutter 12 and the bearings 14, 15 rotate.

The cylinder bearings 14 rotate along races 26 and the balls 14 rotate in roller bearing races 27, Fig. 2. The balls preferably have bigger diameter than the cylinder bearings 14, wherein the radially extreme point of the cylinder bearings touch a line 28, parallel with line 24. The tail 30, according to Fig. 1B, comprises a jacket surface 31, a tail surface or tip 32 and an axially inner surface or end surface 33, which is connected to an active axial stop surface 34 for the bearing 14. The tip 32 is formed at the intersection between the jacket surface 31 and the end surface 33. Gage inserts 37 are provided generally in the jacket surface for retaining the

diameter of the hole and for counteracting erosion of the steel material of the roller cutter.

A seal means 40 is inserted between the roller cutter 12 and the end surface 33 of the leg and is intended to prevent drill cuttings and other impurities from enter into the bearing system. Furthermore, the seal means 40 is intended to retain bearing grease in the bearing system. The seal means 40 is concentrically provided around the bearing journal 11 and is intended to slide against the roller cutter 12. The seal means 40 is more closely shown in Figs. 4 - 7. The seal means consists of an annular one-piece unit consisting of a relatively flexible material 41, such as rubber, and a core or a relatively rigid material 42, such as spring steel. The flexible material is in non-rotational alliance with that rigid material via curing for example. The rigid material 42 is formed as a belleville washer or a cup spring, i.e. it has the shape of a circular ring but where the inner diameter is separated in plane from the outer diameter, for allowing rebound in the axial direction. The rigid material 42 is substantially enclosed by the flexible material 41, wherein at least two surfaces 43, 44 of the seal means are provided as abutment surfaces. A first abutment surface 43 is provided in a plane p and a second abutment surface 44 is provided parallel with this plane, at a distance L. The first abutment surface 43 will be glued to the end surface 33 of the leg, radially inside the line 28. The first abutment surface 43 perpendicularly connects to a third surface 45, which can be glued to a against surface 35 perpendicular to the first abutment surface 43 and provided between the surfaces 33 and 34. The second abutment surface 44 is polished in order to slide easily relatively to a sealing surface 36, provided in the roller cutter 12 perpendicularly to the line 28 and parallel with the end surface 33. The second abutment surface 44 is provided radially outside the line 28. The seal means 40 is provided in axial the direction at both sides of the innermost end surface of the bearing 14. The seal means 40 forms a gap with a surface 38 in the roller cutter to release grease in case the inner pressure in the bearing system becomes great.

The seal means 40 and the bearing journal 11 comprise cooperating locking means 46, 47 and 48, 49, respectively, provided to counteract rotation of the seal means relative to the bearing journal. The locking means 46-49 consist of local diminishing or increasing diameters and preferably comprise concave and convex substantially complementary surfaces provided diametrically opposite each other around the roller cutter axis 24 of rotation. The geometries of the complementary surfaces provides for a simple, exact and safe location of the seal means 40. The bearing journal has a collar 50 at the transition to the leg 10, which collar is defined by the perpendicular surfaces 34 and 35. The collar has a bigger diameter than the leg and has a somewhat bigger thickness in axial direction than the connected portion of the seal means. The collar is most simple provided with circular concave recess 48, 49, the radii center of which are arranged radially outside the collar. It follows thereof that the seal means are arranged with circular convex tongues or projections 46, 47, the radii center of which likewise are arranged radially outside the seal means. The locking means 46, 47 of the seal means 40 substantially extend in the plane P and are provided radially inside the line 28. The locking means 46-49 are provided axially outside the end surface 33 of the leg.

By means of a rock drill bit and a sealing ring according to the present invention the life-span of the bearings can be extended and the mounting is simplified considerably compared to drill bits with conventional seals.

The invention is in no manner limited to the above described embodiments. For example the number of locking means may vary and the shape of the locking means may be polygonal, elliptical, or similar. In addition, the collar may be arranged with convex locking means while the seal means is provided with concave locking means, also if this configuration impairs the manufacture of the bearing journal of the drill bit. Also in other aspects the invention can be freely varied within the scope of the appended claims.

Claims

1. A rock drill bit for rotary crushing machining of rock, including at least one leg (10) carrying a bearing journal (11) provided with bearing surfaces (26,27,34) in order to via bearing element (14,15) cooperate with races in a thereby rotatable roller cutter (12) equipped with crushing organs (13), said leg comprising a tail (30) and seal means (40) intended to counteract entrance of drill cuttings into the bearings, said the seal means (40) in addition being intended to retain bearing grease, said seal means (40) being concentrically provided around the bearing journal (11) and comprising locking means (46,47) provided to counteract rotation of the seal means relative to the bearing journal,
c h a r a c t e r i z e d i n that the seal means (40) is a one-piece unit and is attached via a first surface (43) to an end surface (33) on the leg (10) and that the seal means (40) is intended to slide against the roller cutter (12) via a second surface (44) and that the locking means (46-49) is provided on the bearing journal (11) and on the seal means (40) and that the cooperating locking means comprise concave and convex complementary surfaces (46-49).

2. Rock drill bit according to claim 1,
c h a r a c t e r i z e d i n that the locking means (46-49) is provided axially outside the end surface (33) of the leg and that the seal means (40) is glued against the end surface (33) of the leg.

3. Rock drill bit according to claims 1 or 2,
c h a r a c t e r i z e d i n that the seal means (40) is provided to rebound in the axial direction of the bearing journal and that the complementary surfaces (46-49) are provided diametrically opposite each other around the roller cutter axis (24) of rotation.

4. Rock drill bit according to anyone of the claims 1-3,

characterized in that the seal means (40) consists of an ring comprising of a relatively flexible material (41), such as rubber, and a relatively rigid material (42), such as spring steel, said flexible material being in non-rotational alliance via curing for example to the rigid material and that the rigid material (42) has the shape of a circular ring where the inner diameter is separated in plane from the outer diameter.

5. Rock drill bit according to claim 4,
characterized in that the rigid material (42) is substantially enclosed by the flexible material (41), wherein at least two surfaces (43,44) of the flexible material are provided as abutment surfaces against the end surface (33) of the leg and against a sealing surface (36) of the roller cutter, respectively.

6. Rock drill bit according to claim 5,
characterized in that a first abutment surface (43) is provided in a plane (P) and a second abutment surface (44) is provided parallel with this plane, at a distance (L) therefrom, wherein the first abutment surface (43) is provided to be glued to the end surface (33), /wherein the second abutment surface (44) is polished in order to easy slide relatively a sealing surface (36), provided in the roller cutter (12) substantially parallel to the end surface (33).

7. Seal means for a rock drill bit of the type which are indicated in the claims 1-6,
characterized in that the seal means (40) consists of a one-piece unit and that the seal means (40) comprises locking means (46,47) consisting of local diminishing or increasing internal diameters, wherein the locking means are provided to counteract rotation of the seal means at application and that the locking means comprise concave or convex complementary surfaces (46,47).

8. Seal means according to claim 7,
characterized in that it is provided to be fastened by gluing in connection with mounting.

9. Seal means according to claims 7 or 8,
c h a r a c t e r i z e d i n that the seal means (40) is provided to rebound in the axial direction and that the complementary surfaces (46,47) are provided diametrically opposite each other around the center axis (24) of the seal means (40).

10. Seal means according to anyone of the claims 7-9,
c h a r a c t e r i z e d i n that the seal means (40) consists of an ring consisting of a relatively flexible material (41), such as rubber, and a relatively rigid material (42), such as spring steel, said flexible material being in non-rotational alliance via curing for example to the rigid material and that the rigid material (42) has the shape of a circular ring but where the inner diameter is separated in plane from the outer diameter and that the rigid material (42) is substantially enclosed by the flexible material (41) and that a first abutment surface (43) is provided in a plane (P) and a second abutment surface (44) is provided parallel with this plane, at a distance (L) therefrom, wherein the first abutment surface (43) is provided to be glued and the second abutment surface (44) is polished.

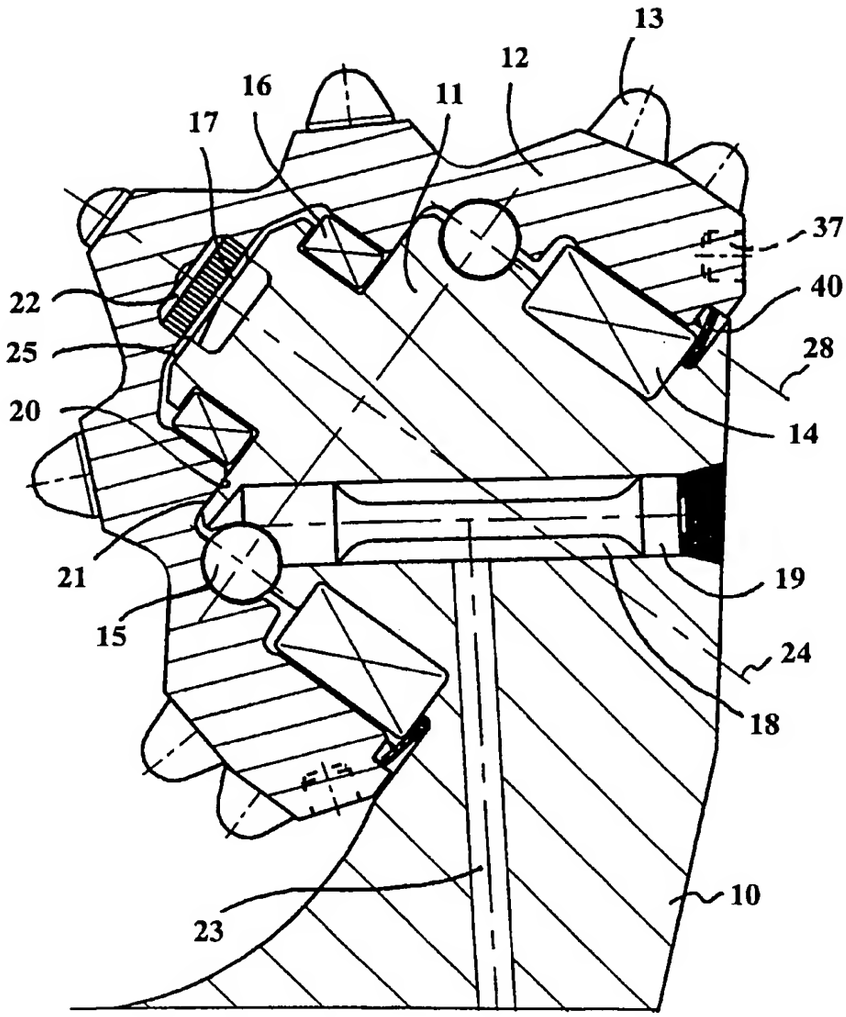

FIG. 1A

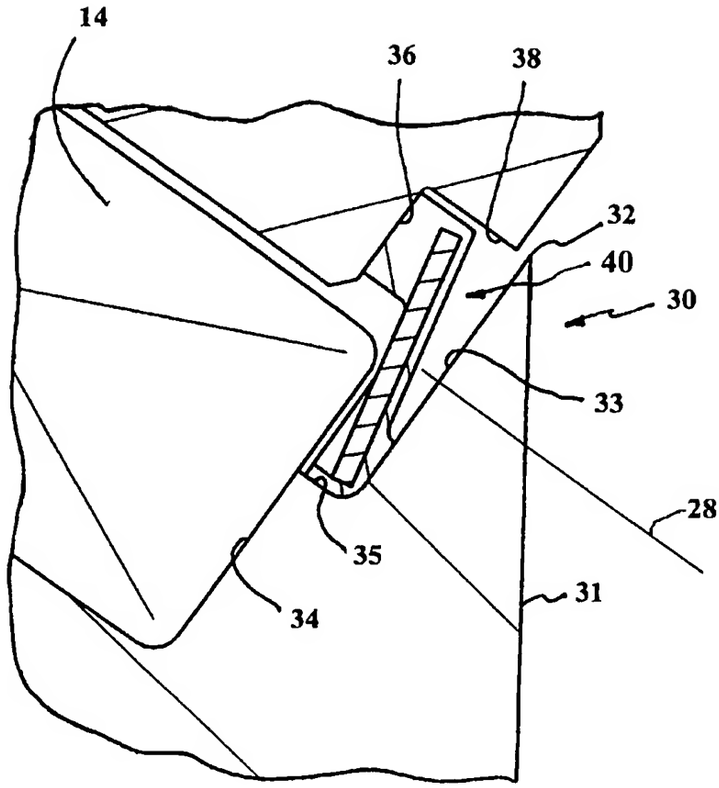

FIG. 1B

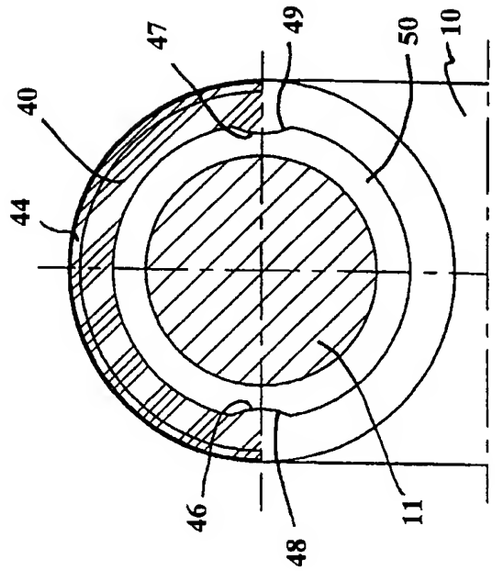

FIG. 3

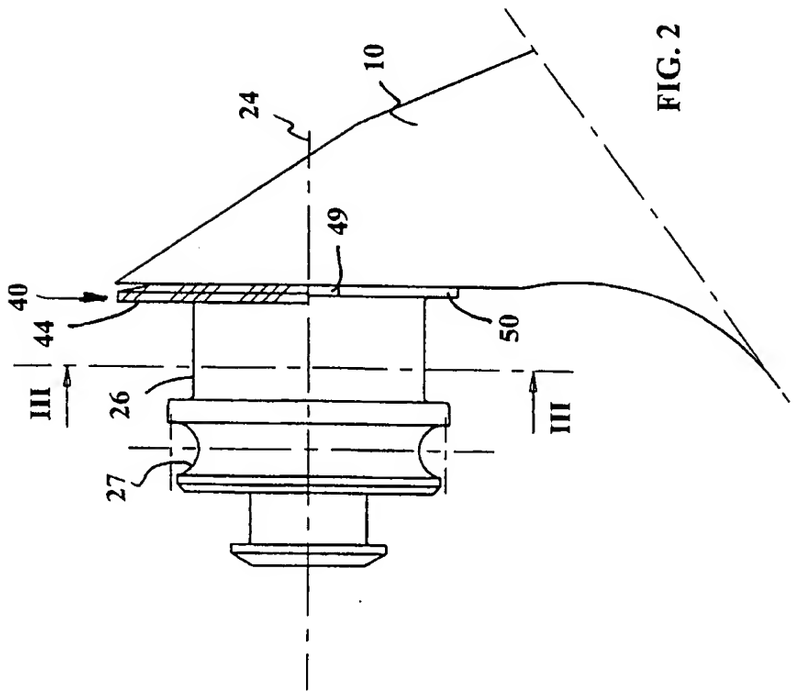

FIG. 2

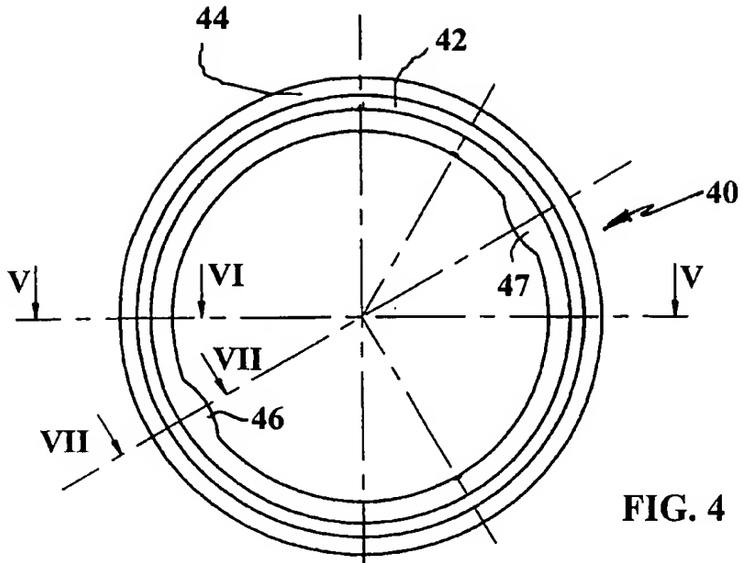

FIG. 4

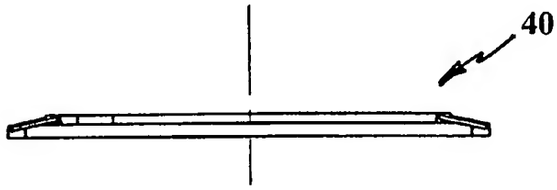

FIG. 5

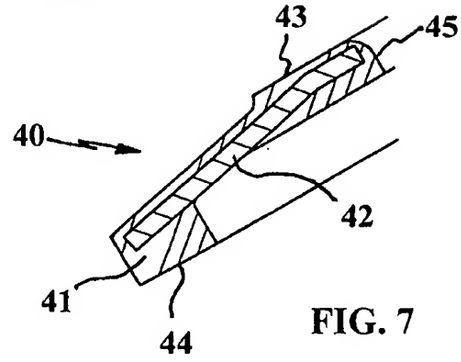

FIG. 7

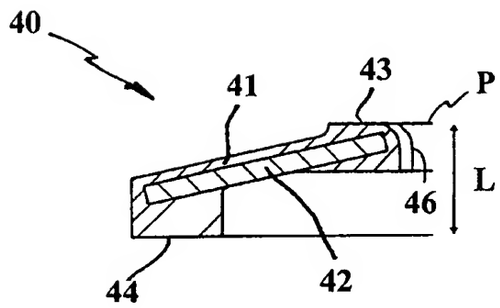

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E21B 10/22
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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 5295549 A (G.E. DOLEZAL ET AL), 22 March 1994 (22.03.94) --	1-10
A	US 3663073 A (C.L. BRONSON), 16 May 1972 (16.05.72) --	1-10
A	US 4560175 A (N.J. KAR ET AL), 24 December 1985 (24.12.85) --	1-10

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International application No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/97

International application No.
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